MARYLAND

CLEAN WATER ACTION PLAN

Unified Watershed Assessment and Priorities

Draft First Year Report

Technical Appendix

August 1, 1998

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INTRODUCTION

This section contains some of the technical information used to develop Maryland's Unified Watershed Assessment and Prioritization for the State's DRAFT 1998 Clean Water Action Plan released on August 1, 1998 and updated on August 24, 1998.

The first section contains a cross-reference table showing the relationship of federal Hydrologic Unit watersheds to the Maryland's watershed segments and Tributary Strategy basins established for controlling nutrients to Chesapeake Bay. For the most part, the State's watershed system fits within the federal system. There are some minor discrepancies, however, over relatively small watershed areas. These are noted in the table.

The second section contains metadata ("data about data") for each of the indicators used in determining Category I (restoration) watersheds and Category III (protection) watersheds.

If you have specific information about technical aspects of the Unified Watershed Assessment or Watershed Prioritization process, please contact Sherm Garrison (sgarrison@dnr.state.md.us) at Tidewater Ecosystem Assessment Division, MD Dept. Natural Resources, Tawes State Office Bldg., D-2, Annapolis, MD 21401.

Relationship between federal watersheds (Hydrologic Units) and Maryland's watershed segment system and Chesapeake Bay Tributary Strategy basins (for nutrient control)

Relationship between federal watersheds (Hydrologic Units) and Maryland's watershed segment system and Chesapeake Bay Tributary Strategy basins (for nutrient control)

Maryland Tributary Strategy Basin Name	Maryland Eight-digit Watershed Code	Maryland Eight-digit Watershed Name	Federal Hydrologic Unit Code	Federal Hydrologic Unit Name
Upper Western Shore	02050301	Conewago Creek	02050306	Lower Susquehanna
	02120201	L Susquehanna River		
	02120202	Deer Creek		
	02120203	Octoraro Creek		
	02120204	Conowingo Dam Susq R		
	02120205	Broad Creek		
Ocean/Coastal Basin **	02130101	Atlantic Ocean	02060010	Chincoteague
	02130102	Assawoman Bay		
	02130103	Isle of Wight Bay		
	02130104	Sinepuxent Bay		
	02130105	Newport Bay		
	02130106	Chincoteague Bay		
Lower Eastern Shore	02130201	Pocomoke Sound	02060009	Pocomoke
	02130202	Lower Pocomoke River		
	02130203	Upper Pocomoke River		
	02130204	Dividing Creek		
	02130205	Nassawango Creek		
	02130206	Tangier Sound		
	02130207	Big Annemessex River		
	02130208	Manokin River		
	02130301	Lower Wicomico River	02060007	Blackwater-Wicomico
	02130302	Monie Bay		
	02130303	Wicomico Creek		
	02130304	Wicomico River Head		
	02130307	Fishing Bay		
	02130308	Transquaking River		
	02130305	Nanticoke River	02060008	Nanticoke
	02130306	Marshyhope Creek		
	02130401	Honga River	02060005	Choptank
Choptank River	02130402	Little Choptank		
	02130403	Lower Choptank		
	02130404	Upper Choptank		
	02130405	Tuckahoe Creek		

Relationship between federal watersheds (Hydrologic Units) and Maryland's watershed segment system and Chesapeake Bay Tributary Strategy basins (for nutrient control) - continued

Maryland Tributary Strategy Basin Name	Maryland Eight-digit Watershed Code	Maryland Eight-digit Watershed Name	Federal Hydrologic Unit Code	Federal Hydrologic Unit Name
Upper Eastern Shore	02130501	Eastern Bay	02060002	Chester-Sassafras
	02130502	Miles River		
	02130503	Wye River		
	02130504	Kent Narrows		
	02130505	Lower Chester River		
	02130506	Langford Creek		
	02130507	Corsica River		
	02130508	Southeast Creek		
	02130509	Middle Chester River		
	02130510	Upper Chester River		
	02130511	Kent Island Bay		
	02130601	Lower Elk River		
	02130602	Bohemia River		
	02130603	Upper Elk River		
	02130604	Back Creek		
	02130605	Little Elk Creek		
	02130606	Big Elk Creek		
	02130608	Northeast River		
	02130609	Furnace Bay		
	02130610	Sassafras River		
	02130611	Stillpond-Fairlee		
--	02130607	Christina River	02040205	Brandywine-Christina
Upper Western Shore	02130701	Bush River	02060003	Gunpowder-Patapsco
	02130702	Lower Winters Run		
	02130703	Atkisson Reservoir		
	02130704	Bynum Run		
	02130705	Aberdeen Proving Ground		
	02130706	Swan Creek		
	02130801	Gunpowder River		
	02130802	Lower Gunpowder Falls		
	02130803	Bird River		
	02130804	Little Gunpowder Falls		
	02130805	Loch Raven Reservoir		
	02130806	Prettyboy Reservoir		
	02130807	Middle River - Browns		
Patapsco-Back River	02130901	Back River		
	02130902	Bodkin Creek		
	02130903	Baltimore Harbor		
	02130904	Jones Falls		
	02130905	Gwynns Falls		
	02130906	Patapsco River L N Br		
	02130907	Liberty Reservoir		
	02130908	S Branch Patapsco		

Relationship between federal watersheds (Hydrologic Units) and Maryland's watershed segment system and Chesapeake Bay Tributary Strategy basins (for nutrient control) - continued

Maryland Tributary Strategy Basin Name	Maryland Eight-digit Watershed Code	Maryland Eight-digit Watershed Name	Federal Hydrologic Unit Code	Federal Hydrologic Unit Name
Lower Western Shore	02131001	Magothy River	02060004	Severn
	02131002	Severn River		
	02131003	South River		
	02131004	West River		
	02131005	West Chesapeake Bay		
Patuxent River	02131101	Patuxent River lower	02060006	Patuxent
	02131102	Patuxent River middle		
	02131103	Western Branch		
	02131104	Patuxent River upper		
	02131105	Little Patuxent River		
	02131106	Middle Patuxent River		
	02131107	Rocky Gorge Dam		
	02131108	Brighton Dam		
--	02139996	Upper Chesapeake Bay	02060001	Upper Chesapeake Bay
	02139997	Middle Chesapeake Bay		
	02139998	Lower Chesapeake Bay		
Lower Potomac River	02140101	Potomac River L tidal	02070011	Lower Potomac
	02140102	Potomac River M tidal		
	02140103	St. Mary's River		
	02140104	Breton Bay		
	02140105	St. Clements Bay		
	02140106	Wicomico River		
	02140107	Gilbert Swamp		
	02140108	Zekiah Swamp		
	02140109	Port Tobacco River		
	02140110	Nanjemoy Creek		
	02140111	Mattawoman Creek		

Relationship between federal watersheds (Hydrologic Units) and Maryland's watershed segment system and Chesapeake Bay Tributary Strategy basins (for nutrient control) - continued

Maryland Tributary Strategy Basin Name	Maryland Eight-digit Watershed Code	Maryland Eight-digit Watershed Name	Federal Hydrologic Unit Code	Federal Hydrologic Unit Name
Middle Potomac River	02140201	Potomac River U tidal	02070010	Middle Potomac-Anacostia-Occoquan
	02140203	Piscataway Creek		
	02140204	Oxon Creek		
	02140205	Anacostia River		
	02140206	Rock Creek		
	02140202	Potomac River MO Cnty	02070008	Middle Potomac-Catoctin
	02140207	Cabin John Creek		
	02140208	Seneca Creek		
Upper Potomac River	02140301	Potomac River FR Cnty		
	02140305	Catoctin Creek		
	02140302	Lower Monocacy River	02070009	Monocacy
	02140303	Upper Monocacy River		
	02140304	Double Pipe Creek		
	02140501	Potomac River WA Cnty	02070004	Conococheague-Opequon
	02140502	Antietam Creek		
	02140503	Marsh Run		
	02140504	Conococheague Creek		
	02140505	Little Conococheague		
	02140506	Licking Creek		
	02140507	Tonoloway Creek		
	02140509	Little Tonoloway Creek		
	02140508	Potomac River AL Cnty	02070003	Cacapon-Town
	02140510	Sideling Hill Creek		
	02140511	Fifteen Mile Creek		
	02140512	Town Creek		
	02141001	Potomac River L N Branch	02070002	North Branch Potomac
	02141002	Evitts Creek		
	02141003	Wills Creek		
	02141004	Georges Creek		
	02141005	Potomac River U N Branch		
	02141006	Savage River		
Youghiogheny River **	05020201	Youghiogheny River *	05020006	Youghiogheny
	05020202	Little Youghiogheny R		
	05020203	Deep Creek Lake		
	05020204	Casselman River		

** - Youghiogheny River watershed includes a small portion of the federal Hydrologic Unit identified as the Cheat River Hydrologic Unit*

*** - The Youghiogeny watershed and the Coastal Bays region are considered to be Tributary Strategy Regions for the purposes of this program*

Source: MD 1998 305(b) Report - Appendices

Metadata of selected watershed segment indicators for Maryland's Unified Watershed Assessment and Prioritization Process

Updated as of 20 September 1998

NOTE: The Youghiogeny watershed and the Coastal Bays region are considered to be Tributary Strategy Regions for the purposes of this program

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Benthic Index of Biotic Integrity (IBI) (non-tidal)

Definition: Multi metric ecological index of benthic macroinvertebrate community health in first- through sixth-order non-tidal streams developed using Maryland Biological Stream Survey (MBSS), Targeted Watersheds Program, Benthic CORE/TREND Program, and Benthic Rapid Bioassessment Program.

Data Sources: Maryland Biological Stream Survey (MBSS), Targeted Watersheds Program, Benthic CORE/TREND Program, Benthic Rapid Bioassessment Program.

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: The Benthic Macroinvertebrate Index score was developed using Maryland Biological Stream Survey (MBSS), Targeted Watershed Project, Benthic CORE/TREND Program, and Rapid Bioassessment Program data. Comparable sampling and scoring methods were used to develop an index from these programs. Scores for watersheds are reported as a mean for the sites sampled within each 8 digit watershed.

Watershed Scale: Tributary Strategy Region ____ USGS 8 Digit ____ MD 6 Digit ____ MD 8 Digit **_X_** MD 12 Digit ____ Any ____

Data Custodian: Marty Hurd (MDNR/RAS/MANTA - 410-260-8604)

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___

If Yes: Benchmark Goal **_X_** Relative Goal ___

Description of Benchmark: For the benthic IBI, reference conditions were established for minimally-impacted streams. IBI values used in this assessment are relative to conditions in these minimally-impacted streams. Note: Although a Multi metric index was developed from published methodologies for the Benthic CORE/TREND , Rapid Bioassessment and Targeted Watersheds Programs, the index for these programs was not rigorously tested and validated as was the MBSS benthic IBI.

Assumptions: _____

Comments: Benthic IBI values based on MBSS data collected from streams greater than 6.0 meters wide (18% of all MBSS sites with benthic IBIs) were not used in the Unified Watershed Assessment. Preliminary benchmarks for selecting potential watershed candidates for Category I or Category III are:
Benthic IBI score <6.0 (Category I) and Benthic IBI score >/=8.0 (Category III).

Benthic IBI (non-tidal) Data Layer - continued

References:

Kazyak, P. 1996. Maryland biological stream survey sampling manual. Maryland Department of Natural Resources. Monitoring and Non-tidal Assessment division. Annapolis, Maryland.

Stribling, J.B., J. White, B. Jessup, D. Boward, and M. Hurd. 1998. Development of a Benthic Index of Biotic Integrity for Maryland Streams. Prepared by Tetra Tech, Inc. for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division. Annapolis, Maryland. DRAFT.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Fish IBI (non-tidal)

Definition: Multimetric ecological index of fish community health in first- through third-order non-tidal streams developed by the MBSS.

Data Source: Maryland Biological Stream Survey (MBSS), MD Dept. Natural Resources

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: The Fish IBI score was developed from Maryland Biological Stream Survey and Targeted Watershed Project data. Fish were collected using the same methods in both programs. Scores for watersheds are reported as means for the sites sampled within each 8 digit watershed.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Any ___

Data Custodian: Marty Hurd (MDNR/RAS/MANTA - 410-260-8604)

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal **_X_** Relative Goal ___
Description of Benchmark: For the fish IBI, reference conditions were established for minimally-impacted streams. IBI values used in this assessment are relative to conditions in these minimally-impacted streams.

Comments: Fish IBI values for streams less than 1.5 meters wide (11% of all sites with fish IBIs) were not used in the Unified Watershed Assessment. Preliminary benchmarks for selecting potential candidate watersheds for Category I or Category III are: *Fish IBI score <6.0 (Category I) and Fish IBI score >/=8.0 (Category III).*

References: Roth, N. E., M. Southerland, J. Chaillou, R. Klauda, P. Kazyak, S. Stranko, S. Weisberg, L. Hall, and R. Morgan. 1997. Maryland Biological Stream Survey: Development of a fish index of biotic integrity. In: Maryland Biological Stream Survey: Ecological status of non-tidal streams in six basins sampled in 1995 (Appendix C). Prepared by Versar, Inc. for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division. Annapolis, Maryland. CBWP-MANTA-EA-97-2.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Instream Physical Habitat (non-tidal)

Definition: Multi-parameter indicator of instream physical habitat quality in first- through third-order non-tidal streams developed by the MBSS.

Data Source: MBSS

Data Type: Condition **_X_** Stressor **_X_** Vulnerability ___ Trend ___ Growth ___ Other___

Method of Calculation: The Instream Physical Habitat Indicator score is based on seven measures of instream habitat quality that are scored for each site based on observations of habitat condition in streams during sample visits. The seven habitat measures rate the quantity and quality of physical habitat available in the stream for fish and benthic macroinvertebrate colonization and rate the degree to which the stream channel has been altered due to perturbations in the watershed landscape. A mean for these seven measures was calculated for each sampled site, and the mean habitat score for each 8 digit watershed expressed on a 1 to 10 scale is reported.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___
MD 8 Digit **_X_** MD 12 Digit ___ Any ___

Data Custodian: Marty Hurd (MDNR/RAS/MANTA - 410-260-8604)

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal **_X_** Relative Goal
Description of Benchmark Goal: The benchmark for habitat quality is the maximum attainable score. Habitat values reported here are relative to this maximum attainable score.

Assumptions: _____

Comments: The MBSS instream physical habitat metrics and scoring criteria were adapted from USEPA's Rapid Bioassessment Protocols and Ohio EPA's Qualitative Habitat Evaluation Index. Preliminary benchmarks for selecting potential candidates for Category I or Category III are: *Top 25% of the Habitat scores (Category III) and Bottom 25% (Category I).*

References: Kazyak, P. 1996. Maryland biological stream survey sampling manual. Maryland Department of Natural Resources. Monitoring and Non-tidal Assessment Division. Annapolis, Maryland.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Nutrient Enrichment Indicators (non-tidal)

Definition: Status of total nitrogen and total phosphorus concentration.

Data Source: CORE/Trend Programs

Data Type: Condition **_X_** Stressor **_X_** Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: **Nutrient Enrichment Indicators** (TN and TP) were developed using the "status" scoring methodology used for Tributary Strategies reporting- expressed on a scale of 1-10.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Any ___

Data Custodian: Marty Hurd (MDNR/RAS/MANTA - 410-260-8604)

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal ___ Relative Goal **_X_**

Assumptions: _____

Comments: _____

References:

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Acidification Indicator (non-tidal)

Definition: Acid neutralizing capacity (ANC) values collected in first- through third-order non-tidal streams by the MBSS. These values provide a measure of the buffering capacity of stream water and the sensitivity of the water to acidic inputs.

Data Source: Maryland Biological Stream Survey (MBSS)

Data Type: Condition **_X_** Stressor **_X_** Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: Water samples were collected during the MBSS Spring Index period and analyzed for acid neutralizing capacity in the laboratory using a modified Grinnel titration method.

Watershed Scale: Tributary Strategy Region ____ USGS 8 Digit ____ MD 6 Digit ____ MD 8 Digit **_X_** MD 12 Digit ____ Any ____

Data Custodian: Marty Hurd (MDNR/RAS/MANTA - 410-260-8604)

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ____
If Yes: Benchmark Goal **_X_** Relative Goal ___
Description of Benchmark Goal: Sites with ANC values < 0 μeq/L are chronically acidic, while sites with ANC values > 200 μeq/L are generally not susceptible to acidification.

Assumptions:_____

Comments: Preliminary benchmarks for selecting potential candidate watersheds for Category I and Category III are: *</= 0 ueq/l (Category I) and >200 ueq/l (Category III).*

References: Kazyak, P. 1996. Maryland biological stream survey sampling manual. Maryland Department of Natural Resources. Monitoring and Non-tidal Assessment Division. Annapolis, Maryland.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Migratory Fish Spawning Areas

Definition: Living Resources indicator that rates watersheds based on the diversity of spawning habitat for American Shad, Hickory Shad, Alewife, Blueback Herring, White Perch, Striped Bass, and Yellow Perch.

Data Sources: MDNR Fisheries Service, U.S. Fish and Wildlife Service, Chesapeake Bay Program.

Data Type: Condition **_X_** Stressor ___ Vulnerability **_X_** Trend ___ Growth ___ Other ___

Method of Calculation: The Migratory Fish Spawning Areas Indicator was developed using MDNR Fisheries Service information and *Habitat Requirements for Chesapeake Bay Living Resources* (Funderburk et al. 1991). This indicator scores watersheds based on the number of migratory fish species (0 - 7) that spawn within the watershed.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Any ___

Data Custodian: Marty Hurd (MDNR/RAS/MANTA - 410-260-8604)

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ____
If Yes: Benchmark Goal ___ Relative Goal **_X_**

Assumptions: _____

Comments: Preliminary benchmarks for selecting potential candidate watersheds for Category III only are: *Migratory Fish Spawning Areas Indicator score > 0.*

References: O'Dell, J., J. Gabor, R. Dintamin, & J. Mowrer. 1976. Survey of Anadromous Fish Spawning Areas. Proj. AFC-9-1. In cooperation with the National Marine Fisheries Service.

Weinrich, D.W., M.E. Dore, & W.R. Carter, III. 1983. Investigation of American shad in the upper Chesapeake Bay. Proj. F-37-R Annual report to U.S. Fish & Wildlife Service.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky, and D. Riley (Eds.). 1991. Habitat Requirements for Chesapeake Bay Living Resources, Second Edition. Prepared for the Living Resources Subcommittee, Chesapeake Bay Program.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Imperiled Aquatic Species (non-tidal)

Definition: Living Resources indicator that rates watersheds according to number and diversity of aquatic species listed as rare, endangered, threatened, or otherwise of special concern.

Data Sources: MD Dept. Natural Resources - Maryland Biological Stream Survey, Wildlife and Heritage Division, and Fisheries Service

Data Type: Condition _**X**_ Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: The Imperiled Aquatic Species Indicator was developed using the MDNR Wildlife and Heritage Division listing information for amphibian, fish, crayfish and mussel species. Distributions of these animals within the 134 (8 digit) watersheds were determined and scored from 0 -10 based on the number of sites with rare species, their status (endangered, rare...), and the diversity of aquatic animals within each 8 digit watershed.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit _**X**_ MD 12 Digit ___ Any ___

Data Custodian: Marty Hurd (MDNR/RAS/MANTA - 410-260-8604)

Clean Water Goal: Yes ____ No _**X**_

Other Natural Resource Goal: Yes _**X**_ No ____
If Yes: Benchmark Goal ___ Relative Goal _**X**_

Assumptions: _____

Comments: Preliminary benchmarks for selecting potential candidate watersheds for Category III only are: *Imperiled Aquatic Species Indicator score > 0.*

References: MDNR (Maryland Department of Natural Resources). 1994. Rare, threatened, and endangered animals of Maryland. Maryland Natural Heritage Program. Annapolis, Maryland.

Kazyak, P. 1996. Maryland biological stream survey sampling manual. Maryland Department of Natural Resources. Monitoring and Non-tidal Assessment division. Annapolis, Maryland.

Memorandum dated 8 July 1998 From Bob Lunsford to Paul Massicot

Appendix to Metadata for Imperiled Aquatic Species Indicator (non-tidal)

The following species were used to calculate the IASI score. Species were either classed as T1 (state rare, watch list, possibly rare) or T2 (highly state rare, endangered, or threatened).

T1 - species	T2 - species
ALEWIFE FLOATER	IRONCOLOR SHINER
AMERICAN BROOK LAMPREY	LOGPERCH
BANDED DARTER	MUD SUNFISH
CAMBARUS ACUMINATUS	GLASSY DARTER
CHECKERED SCULPIN	HELLBENDER
COMELY SHINER	STONECAT
EASTERN MUD TURTLE	STRIPEBACK DARTER
FLIER	
JEFFERSON SALAMANDER	
JOHNNY DARTER	
NORTHERN LANCE	
ORCONECTES OBSCURUS	
PEARL DACE	
QUEEN SNAKE	
RAINBOW DARTER	
SPOTTED TURTLE	
SQUAWFOOT	
STRIPED SHINER	
SWAMP DARTER	
WARMOUTH	
WOOD TURTLE	
YELLOW LANCE	

8-digit watersheds were scored based on the presence of combinations of T1 and T2 species.

Indicator score	Scoring criteria
10	Presence of two T2 species within an 8-digit watershed
9	Presence of one T2 species within an 8-digit watershed
8	Presence of three T1 species within an 8-digit watershed
7	Presence of two T1 species within an 8-digit watershed
6	Presence of one T1 species within an 8-digit watershed
0	None
.	NA (no sampling sites in watershed)

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Trout Spawning Areas (non-tidal)

Definition: Living Resources indicator that identifies watersheds where populations of brown, rainbow, and brook trout are known to reproduce.

Data Sources: MD Dept. Natural Resources, Maryland Biological Stream Survey (MBSS) and Fisheries Service

Data Type: Condition _**X**_ Stressor ___ Vulnerability _**X**_ Trend ___ Growth ___ Other ___

Method of Calculation: The Trout Spawning Areas Indicator was developed using Maryland Biological Stream Survey data and information provided by the Fisheries Service. This indicator scores watersheds based on the diversity of trout spawning areas within the watershed. Because brook trout are the only native trout (Salmonidae) species that spawn in Maryland waters, they were weighted more heavily than either rainbow or brown trout.

Indicator score	Scoring criteria
10	Presence of brook, brown, and rainbow trout spawning habitat
9	Presence of brook and brown spawning habitat
8	Presence of (only) brook trout spawning habitat
7	Presence of brown and rainbow trout spawning habitat
6	Presence of (only) rainbow trout spawning habitat
5	Presence of (only) brown trout spawning habitat
0	None
.	NA (trout spawning habitat not expected to occur)

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit _**X**_ MD 12 Digit ___ Any ___

Data Custodian: Marty Hurd (MDNR/RAS/MANTA - 410-260-8604)

Clean Water Goal: Yes ____ No _**X**_

Other Natural Resource Goal: Yes _**X**_ No ____
If Yes: Benchmark Goal ___ Relative Goal _**X**_

Assumptions: _____

Trout Spawning Areas (non-tidal) Data Layer - continued

Comments: Preliminary benchmarks for selecting potential candidate watersheds for Category III only are: *Trout Spawning Areas indicator score > 0*.

References: Kazyak, P. 1996. Maryland biological stream survey sampling manual. Maryland Department of Natural Resources. Monitoring and Non-tidal Assessment division. Annapolis, Maryland.

Memorandum dated 8 July 1998 From Bob Lunsford to Paul Massicot

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Tidal Water Quality "Habitat Status Index"

Definition (General Description): This index is the mean of current status (1994-1996) information, scored according to a 10-level scale, for surface chlorophyll *a*, secchi depth and summer (July - September) bottom dissolved oxygen. Values are consolidated into a single mean for each major tidal tributary. For more information, please see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project".

Data Source: Maryland Department of Natural Resources Tidal Water and Habitat Quality Monitoring Program

Data Type: Condition _**X**_ Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: Current status (1994-1996) was determined for each of the three index components according to methods used for Tributary Strategies assessments (see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information). Individual components status scores were converted to a score of 1 (most degraded) to 10 (best condition) and then combined into an overall index mean by station. For 8-digit watersheds that included more than one station, these overall index means by station were then averaged to determine the watershed mean (which is the same as the overall index mean when only one station is in an 8-digit watershed). Finally, these 8-digit watershed means were averaged within larger drainage basins (for the Potomac, Patuxent, Choptank, Nanticoke, and Elk Rivers). From this last step, multiple 8-digit watersheds are given the same overall index INRA/UWA score to reflect the interactions of watersheds upstream and downstream of each other within a tributary basin.

For the UWA, watersheds are placed in Category I (needs restoration) if they are in the lower 25% of scores for the 138 watersheds for the Habitat Status Index. Watersheds are placed in Category II (needs preventative action) if they have scores in the higher 75% of scores for the 138 watersheds. Because no system is considered to be pristine, none of the watersheds are placed in Category III (pristine watersheds).

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit _**X**_ MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ____No _**X**_

Other Natural Resource Goal: Yes ____ No _**X**_

Assumptions: _____

Tidal Water Quality "Habitat Status" Data Layer - continued

Comments: While we have attempted to meet the needs of the INRA/UWA assessment by providing tidal water and habitat quality data in a useful way through scored indices, we have concerns about the usefulness of the resulting scores. Some of these concerns include:

- Use of relative status: The assignment of status scores to most of the individual parameters (chlorophyll *a*, and Secchi depth) that are incorporated into the two indices is done using a relative scale, so they are of less usefulness in targeting restoration needs (because they are not based on numeric goals)

- The consolidation of data in overly simplistic indices: The combination of the individual parameters into the indices was done as a first-cut for the purposes of reducing the number of parameters reported to the modeling group by doing a first-level assessment of the data. The resulting indices are new, and therefore untested, and we recommend strongly that as the INRA/UWA process continues, the resulting assessments should be compared to determine consistency with established watershed assessments such as the 305b Report.

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Tidal Water Quality "Habitat Trends Index"

Definition (General Description): This index is the mean of long-term (1985-1996) trends information, scored according to a 10-level scale, for surface chlorophyll *a*, secchi depth and summer (July - September) bottom dissolved oxygen. Values are consolidated into a single mean for each major tidal tributary. For more information, please see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project".

Data Source: Dept of Natural Resources, Tidal Water and Habitat Quality Monitoring Program

Data Type: Condition ___ Stressor ___ Vulnerability ___ Trend _**X**_ Growth ___ Other____

Method of Calculation: Long-term trends (1985-1996) were determined for each of the three index components according to methods used for Tributary Strategies assessments (see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information). Individual components trends were scored based on significance and direction from score of 1 (highly significant degrading trend) to 10 (highly significant improving trend) and then combined into an overall index mean by station. For 8-digit watersheds that included more than one station, these overall index means by station were then averaged to determine the watershed mean (which is the same as the overall index mean when only one station is in an 8-digit watershed). Finally, these 8-digit watershed means were averaged within larger drainage basins (for the Potomac, Patuxent, Choptank, Nanticoke, and Elk Rivers). From this last step, multiple 8-digit watersheds are given the same overall index INRA/UWA score to reflect the interactions of watersheds upstream and downstream of each other within a tributary basin.

For the UWA, watersheds are placed in Category I (needs restoration) if they are scored less than 5 (degrading trends). Watersheds are placed in Category II (needs preventative action) if they have scores greater than 5 (improving trends). Because no system is considered to be pristine, none of the watersheds are placed in Category III (pristine watersheds).

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit _**X**_ MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ___ No _**X**_

Other Natural Resource Goal: Yes ___ No _**X**_

Assumptions: _____

Tidal Water Quality "Habitat Trends" Data Layer - continued

Comments: While we have attempted to meet the needs of the INRA/UWA assessment by providing tidal water and habitat quality data in a useful way through scored indices, we have concerns about the usefulness of the resulting scores. Some of these concerns include:

- The consolidation of data in overly simplistic indices: The combination of the individual parameters into the indices was done as a first-cut for the purposes of reducing the number of parameters reported to the modeling group by doing a first-level assessment of the data. The resulting indices are new, and therefore untested, and we recommend strongly that as the INRA/UWA process continues, the resulting assessments should be compared to determine consistency with established watershed assessments such as the 305b Report.

- Links with non-tidal indices. With this as an objective, data should be analyzed in a similar manner so similar indices could be calculated. MANTA has been very willing to coordinate their indices with TEA analyses (which were largely done for other purposes), but due to the short time frame, exact correlation between indices may not be possible for this preliminary analysis.

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Tidal Water Quality "Eutrophication Status Index"

Definition (General Description): This index is the mean of current status (1994-1996) information, scored according to a 10-level scale, for surface mixed layer total nitrogen, total phosphorus and total suspended solids. Values are consolidated into a single mean for each major tidal tributary. For more information, please see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project".

Data Source: Maryland Department of Natural Resources Tidal Water and Habitat Quality Monitoring Program

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other **___**

Method of Calculation: Current status (1994-1996) was determined for each of the three index components according to methods used for Tributary Strategies assessments (see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information). Individual components status scores were converted to a score of 1 (most degraded) to 10 (best condition) and then combined into an overall index mean by station. For 8-digit watersheds that included more than one station, these overall index means by station were then averaged to determine the watershed mean (which is the same as the overall index mean when only one station is in an 8-digit watershed). Finally, these 8-digit watershed means were averaged within larger drainage basins (for the Potomac, Patuxent, Choptank, Nanticoke, and Elk Rivers). From this last step, multiple 8-digit watersheds are given the same overall index INRA/UWA score to reflect the interactions of watersheds upstream and downstream of each other within a tributary basin.

For the UWA, watersheds are placed in Category I (needs restoration) if they are in the lower 25% of scores for the 138 watersheds for the Eutrophication Status Index. Watersheds are placed in Category II (needs preventative action) if they have scores in the higher 75% of scores for the 138 watersheds. Because no system is considered to be pristine, none of the watersheds are placed in Category III (pristine watersheds).

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___
MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___Other**___**

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ___ No **_X_**

Tidal Water Quality "Eutrophication Status Index" Data Layer - continued

Other Natural Resource Goal: Yes ____ No _X_

Assumptions: _____

Comments: While we have attempted to meet the needs of the INRA/UWA assessment by providing tidal water and habitat quality data in a useful way through scored indices, we have concerns about the usefulness of the resulting scores. Some of these concerns include:

- Use of relative status: The assignment of status scores to most of the individual parameters (total nitrogen, total phosphorus, total suspended) that are incorporated into the two indices is done using a relative scale, so they are of less usefulness in targeting restoration needs (because they are not based on numeric goals)
- The consolidation of data in overly simplistic indices: The combination of the individual parameters into the indices was done as a first-cut for the purposes of reducing the number of parameters reported to the modeling group by doing a first-level assessment of the data. The resulting indices are new, and therefore untested, and we recommend strongly that as the INRA/UWA process continues, the resulting assessments should be compared to determine consistency with established watershed assessments such as the 305b Report.

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Tidal Water Quality "Eutrophication Trend Index"

Definition (General Description): This index is the mean of long-term (1985-1996) trends information, scored according to a 10-level scale, for surface mixed layer total nitrogen, total phosphorus and total suspended solids. Values are consolidated into a single mean for each major tidal tributary. For more information, please see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project".

Data Source: Maryland Department of Natural Resources Tidal Water and Habitat Quality Monitoring Program

Data Type: Condition ___ Stressor ___ Vulnerability ___ Trend _**X**_ Growth ___ Other ___

Method of Calculation: Long-term trends (1985-1996) were determined for each of the three index components according to methods used for Tributary Strategies assessments (see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information). Individual components trends were scored based on significance and direction from score of 1 (highly significant degrading trend) to 10 (highly significant improving trend) and then combined into an overall index mean by station. For 8-digit watersheds that included more than one station, these overall index means by station were then averaged to determine the watershed mean (which is the same as the overall index mean when only one station is in an 8-digit watershed). Finally, these 8-digit watershed means were averaged within larger drainage basins (for the Potomac, Patuxent, Choptank, Nanticoke, and Elk Rivers). From this last step, multiple 8-digit watersheds are given the same overall index INRA/UWA score to reflect the interactions of watersheds upstream and downstream of each other within a tributary basin.

For the UWA, watersheds are placed in Category I (needs restoration) if they are scored less than 5 (degrading trends). Watersheds are placed in Category II (needs preventative action) if they have scores greater than 5 (improving trends). Because no system is considered to be pristine, none of the watersheds are placed in Category III (pristine watersheds).

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit _**X**_ MD 12 Digit ___ Adaptable to Any Scale ___ Other___

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ___ No _**X**_

Other Natural Resource Goal: Yes ___ No _**X**_

Tidal Water Quality "Eutrophication Trend Index" Data Layer - continued

Assumptions: _____

Comments: While we have attempted to meet the needs of the INRA/UWA assessment by providing tidal water and habitat quality data in a useful way through scored indices, we have concerns about the usefulness of the resulting scores. Some of these concerns include:

- The consolidation of data in overly simplistic indices: The combination of the individual parameters into the indices was done as a first-cut for the purposes of reducing the number of parameters reported to the modeling group by doing a first-level assessment of the data. The resulting indices are new, and therefore untested, and we recommend strongly that as the INRA/UWA process continues, the resulting assessments should be compared to determine consistency with established watershed assessments such as the 305b Report.

- Links with non-tidal indices. With this as an objective, data should be analyzed in a similar manner so similar indices could be calculated. MANTA has been very willing to coordinate their indices with TEA analyses (which were largely done for other purposes), but due to the short time frame, exact correlation between indices may not be possible for this preliminary analysis.

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: SAV Population Health (abundance)

Definition (General Description): Submerged aquatic vegetation (SAV) population health is determined by measuring the extent of areas with SAV growth each year. SAV coverage is assessed from aerial surveys and quantified by Chesapeake Bay Program segments using digital techniques. These coverage estimates are compared to the SAV Restoration Goals to determine progress towards restoration of healthy SAV populations. Each tributary has its own SAV Restoration Goals (in hectacres) which are based on the amount of area expected to be available for SAV growth, determined by water depth, physical characteristics, and historic occurrence of SAV.

Data Source: VIMS 1996 SAV aerial survey

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other **___**

Method of Calculation: Using the 1996 aerial survey results, we divided the area found in 1996 by the Tier III target (restoring SAV to 2 meters depth) area. This value was multiplied by 10 to yield a value between 0 and 10. If this value was less than 1, 1 was used as the index, as INRA/UWA requires a non-zero value. With a few exceptions (see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information), the mean of the indices for the bay segments that were pooled together was used.

For the UWA, watersheds are placed in Category I (needs restoration) if they have SAV coverage of 10% or less of the Tier III target area (index score of 1) Watersheds are placed in Category II (needs preventative action) if they have SAV coverage of more than 10% of the Tier III target area (index score greater than 1). Because no system is considered to be pristine, none of the watersheds are placed in Category III (pristine watersheds).

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___Other: *For some watersheds, the index score is an extrapolated value due to the nature of the measurements. SAV area goals are determined for Chesapeake Bay Program segments, which include more than a single 8-digit watershed. In such cases, all 8-digit watersheds that are included within a given Bay Segment are given the same SAV Population Health Score.*

Data Custodian: Virginia Institute of Marine Science/MD Dept. Natural Resources-TEA

Clean Water Goal: Yes **___** No **_X_**

Other Natural Resource Goal: Yes **_X_** No **____**
If Yes: Benchmark Goal ___ Relative Goal **_X_**

SAV Population Health (abundance) Data Layer - continued

Assumptions: _____

Comments: *Problems encountered with INRA SAV Indices*:

- We are unable to resolve SAV coverage to watershed level, as most individual watersheds have no data. Future analyses may improve resolution in areas that have multiple stations per bay segment.

- A fundamental, not easily resolved problem deals with data obtained in tributaries that have multiple bay segments (Patuxent, Potomac, and Choptank Rivers) as the bay segments upstream influence those downstream. For this analysis, we chose to obtain a mean for all segments and apply this value to all sheds draining into the tributary. There has to be a better way to do this. Also how should we handle data collected from the mainstem of the Chesapeake Bay?

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: SAV Habitat Requirement Attainment

Definition (General Description): Using 1994 to1996 data, CBP Bay segments passing, failing and borderline to the habitat requirements for SAV (Batiuk *et al.*, 1991) were assessed.

Data Source: MD Dept. Natural Resources - Tidal Water and Habitat Quality Monitoring Program

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other **___**

Method of Calculation: Using 1994 to 1996 data, CBP bay segments passing, failing and borderline to the habitat requirements for SAV (Batiuk *et al.*, 1991) were assessed. Each parameter was weighted as to its importance to SAV and passing failing and borderline value were assigned by the following scale:

Parameter	Passing	Borderline	Failing
Secchi depth	2	1	0
Dissolved inorganic nitrogen	1	0.5	0
Dissolved inorganic phosphorus	1	0.5	0
Chlorophyll *a*	1	0.5	0
Total suspended solids	1	0.5	0

The values were summed and divided by the total score possible (six in mesohaline and polyhaline areas, and five in tidal fresh and oligohaline regiond since dissolved inorganic nitrogen is not a habitat requirement in these areas). This quotient was then multiplied by 10 to yield a value between 0 and 10. Indices less than 1 were changed to 1. With a few exceptions (see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation"), the mean of the indices for the bay segments were pooled and used.

For the UWA, watersheds are placed in Category I (needs restoration) if they are scored less than 7. Watersheds are placed in Category II (needs preventative action) if they are scored 7 or higher, which is only possible if secchi depth is at least "borderline" **and** at least 3 of the remaining 4 (in mesohaline and polyhaline areas) or 2 or the remaining 3 (in tidal fresh and oligohaline areas) other habitat requirements are "passing" **and** the last one at least is "borderline". **Please note:** the numbers in the table above are used to score the individual segments as a first step, which is then standardized to a scale of 1 to 10 by dividing the initial score by the number of habitat requirements that apply (in some areas only four habitat requirements apply; dissolved inorganic nitrogen habitat requirements do not apply in tidal fresh and oligohaline areas). The score of 7 is the standardized score which was reported for the data layer. Because no system is considered to be pristine, none of the watersheds are placed in Category III (pristine watersheds).

SAV Habitat Requirements Attainment Data Layer - continued

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___
MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___
Other *For some watersheds, the index score is an extrapolated value due to the nature of the measurements. SAV Habitat requirements are assessed for Chesapeake Bay Program segments, which include more than a single 8-digit watershed. In such cases, all 8-digit watersheds that are included within a given Bay Segment are given the same SAV Habitat Requirement Score, even if the watershed does not actually include a water quality monitoring station.*

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal **_X_** Relative Goal ___
Description of Benchmark: *SAV Habitat Requirements*

Assumptions: _____

Comments: *Problems encountered with INRA SAV Indices*:

- Due to time constraints, we were not able to perform 1997 SAV habitat requirement attainment analyses. For future work, the most recent year's water quality data will be used.

- We are unable to resolve SAV habitat requirement data to watershed level, as most individual watersheds have no data. Future analyses may improve resolution in areas that have multiple stations per bay segment.

- A fundamental, not easily resolved problem deals with data obtained in tributaries that have multiple bay segments (Patuxent, Potomac, and Choptank Rivers) as the bay segments upstream influence those downstream. For this analysis, we chose to obtain a mean for all segments and apply this value to all sheds draining into the tributary. There has to be a better way to do this. Also how should we handle data collected from the mainstem of the Chesapeake Bay?

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information;

Batiuk et al. 1991. Submerged Aquatic Vegetation Habitat Requirements and Restoration Targets: A Technical Synthesis. Chesapeake Bay Program. Annapolis, Maryland. 186 p.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Estuarine Benthic Index of Biotic Integrity- Status index

Definition (General Description): Benthic communities are sampled at 18 fixed sites in Maryland tidal tributaries. The Chesapeake Bay Benthic Index of Biotic Integrity (B-IBI) evaluates whether the benthic community at a site meets the Restoration Goals, scoring on measures of species diversity, species composition, productivity, and trophic composition (Ranasinghe et al. 1997). Un-impacted reference site attributes were used to define Restoration Goals scales for each type of benthic habitat found in the Chesapeake Bay with the exception of the tidal fresh habitat. Specific numerical ranges are established for three categories for each criteria measured: scores are based on whether the community approximates (a score of 5), deviates slightly from (a score of 3) or deviates strongly from (a score of 1) the characteristics of the attribute at the best reference sites (Weisburg et al. 1997).

Data Source: Maryland Department of Natural Resources Benthic Monitoring Program

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___
Other: *For some watersheds, the index score is an extrapolated value*

Method of Calculation: Unimpacted reference site attributes were used to define Restoration Goals scales for each type of benthic habitat found in the Chesapeake Bay with the exception of the tidal fresh habitat. Specific numerical ranges are established for three categories for each criteria measured: scores are based on whether the community approximates (a score of 5), deviates slightly from (a score of 3) or deviates strongly from (a score of 1) the characteristics of the attribute at the best reference sites (Weisburg et al. 1997). These individual attribute scores are then averaged to determine the Benthic IBI (B-IBI). Communities with a B-IBI of 3.0 or greater are classified as meeting the Restoration Goals, sites with B-IBIs greater than 2.6 but less than 3.0 are classified as marginal, sites with B-IBIs from 2 to 2.6 are classified as degraded, and sites with B-IBIs less than or equal to 2 are classified as severely degraded. Status is defined as the overall current (most recent three years) B-IBI score for each station. For the INRA/UWA project, Benthic IBI current status were assessed to provide a score on the scale from 1 (most severely degraded) to 10 (meets goals-highest quality). A mean of the B-IBI status INRA/UWA scores was calculated by station. For 8-digit watersheds that included more than one station, these means by station were then averaged to determine the watershed mean (which is the same as the overall index mean when only one station is in an 8-digit watershed). Finally, these 8-digit watershed means were averaged within larger drainage basins (for the Potomac, Patuxent and Choptank Rivers). From this last step, multiple 8-digit watersheds are given the same overall index INRA/UWA score to reflect the interactions of watersheds upstream and downstream of each other within a tributary. See "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information.

Estuarine Benthic Index of Biotic Integrity Status Index" Data Layer - continued

Methods - continued

For the UWA, watersheds are placed in Category I (needs restoration) if they are scored less than 6 (does not meet goals). Watersheds are placed in Category II (needs preventative action) if they have scores greater than or equal to 6 (meets goals). Because no system is considered to be pristine, none of the watersheds are placed in Category III (pristine watersheds).

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit _**X**_ MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ____ No _X_

Other Natural Resource Goal: Yes _X_ No ____

If Yes: Benchmark Goal _X_ Relative Goal

Description of Benchmark: *Estuarine Benthic Index of Biotic Integrity Chesapeake Bay Restoration Goals*

Assumptions: _____

Comments: We assigned INRA/UWA scores to the Benthic IBI status in such a way as to maintain the qualitative information applied to Benthic IBI scores for the purposes of the Chesapeake Bay Program. While this seems to be a good first approximation for the purposes of this "preliminary" assessment (expecting that we will continue to refine the INRA/UWA process), additional information may be useful for future attempts (e.g. linkages between Benthic IBI and low dissolved oxygen concentrations).

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information.

Ranasinghe, J. A., L. C. Scott, F. S. Kelley (1997) Chesapeake Bay Water Quality Monitoring Program Long-term Benthic Monitoring and Assessment Component Level 1 Comprehensive Report (July 1984- December 1996). Maryland Department of Natural Resources. Annapolis, Maryland. 46 p.

Weisburg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen. 1997. An estuarine benthic index of biotic integrity (B-IBI) for Chesapeake Bay. Estuaries. 20(1): 149-158.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Estuarine Benthic Index of Biotic Integrity- Trend index

Definition (General Description): Benthic communities are sampled at 18 fixed sites in Maryland tidal tributaries. The Chesapeake Bay Benthic Index of Biotic Integrity (B-IBI) evaluates whether the benthic community at a site meets the Restoration Goals, scoring on measures of species diversity, species composition, productivity, and trophic composition (Ranasinghe et al. 1997). Un-impacted reference site attributes were used to define Restoration Goals scales for each type of benthic habitat found in the Chesapeake Bay with the exception of the tidal fresh habitat. Specific numerical ranges are established for three categories for each criteria measured: scores are based on whether the community approximates (a score of 5), deviates slightly from (a score of 3) or deviates strongly from (a score of 1) the characteristics of the attribute at the best reference sites (Weisburg et al. 1997).

Data Source: Maryland Department of Natural Resources Benthic Monitoring Program

Data Type: Condition ___ Stressor ___ Vulnerability ___ Trend _**X**_ Growth ___ Other___

Method of Calculation: Un-impacted reference site attributes were used to define Restoration Goals scales for each type of benthic habitat found in the Chesapeake Bay with the exception of the tidal fresh habitat. Specific numerical ranges are established for three categories for each criteria measured: scores are based on whether the community approximates (a score of 5), deviates slightly from (a score of 3) or deviates strongly from (a score of 1) the characteristics of the attribute at the best reference sites (Weisburg et al. 1997). These individual attribute scores are then averaged to determine the B-IBI. Communities with a B-IBI of 3.0 or greater are classified as meeting the Restoration Goals, sites with B-IBIs greater than 2.6 but less than 3.0 are classified as marginal, sites with B-IBIs from 2 to 2.6 are classified as degraded, and sites with B-IBIs less than or equal to 2 are classified as severely degraded. Trends are tested using the non-parametric technique of van Belle and Hughes (1984). For the INRA/UWA project, these trends were scored based on the level of significance (p-value) and qualitative direction of trend from score of 1 (highly significant degrading trend) to 10 (highly significant improving trend) and then combined into an overall index mean by station. For 8-digit watersheds that included more than one station, these means by station were then averaged to determine the watershed mean (which is the same as the overall index mean when only one station is in an 8-digit watershed). Finally, these 8-digit watershed means were averaged within larger drainage basins (for the Potomac, Patuxent and Choptank Rivers). From this last step, multiple 8-digit watersheds are given the same overall index INRA/UWA score to reflect the interactions of watersheds upstream and downstream of each other within a tributary. See “Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project” for more information.

Estuarine Benthic Index of Biotic Integrity Trends Index Data Layer - continued

Methods - continued

For the UWA, watersheds are placed in Category I (needs restoration) if they are scored less than 5 (degrading trends). Watersheds are placed in Category II (needs preventative action) if they have scores greater than 5 (improving trends). Because no system is considered to be pristine, none of the watersheds are placed in Category III (pristine watersheds).

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___ Other *For some watersheds, the index score is an extrapolated value.*

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal **_X_** Relative Goal ___
Description of Benchmark: *Estuarine Benthic Index of Biotic Integrity Chesapeake Bay Restoration Goals*

Assumptions: _____

Comments: We assigned INRA/UWA scores to the Benthic IBI trends information in the same manner as used for the water quality indices. While this seems to be a good first approximation for the purposes of this "preliminary" assessment (expecting that we will continue to refine the INRA/UWA process), additional information may be useful for future attempts (e.g. linkages between Benthic IBI and low dissolved oxygen concentrations).

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information.

Ranasinghe, J. A., L. C. Scott, F. S. Kelley (1997) Chesapeake Bay Water Quality Monitoring Program Long-term Benthic Monitoring and Assessment Component Level 1 Comprehensive Report (July 1984- December 1996). Maryland Department of Natural Resources. Annapolis, Maryland. 46 p.

Weisburg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen. 1997. An estuarine benthic index of biotic integrity (B-IBI) for Chesapeake Bay. Estuaries. 20(1): 149-158.

van Belle, G. and J.P. Hughes. 1984. Nonparametric tests for trend in water quality. Water Resources Research 20(1):127-136.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Estuarine Fish Index of Biotic Integrity

Definition (General Description): Data are collected monthly (July - September). Multiple sites are sampled on each river system. Abundance by species is calculated. These data are summed for the entire season and reduced to metrics: total number of species, number of species comprising 90% of the catch, number of species in the bottom trawl, anadromous fish abundance, estuarine fish abundance, total fish abundance less menhaden, proportion of planktivores, proportion of carnivores, proportion of benthivores

Data Source: Maryland Department of Natural Resources Resource Assessment Service, Index of Biotic Integrity sampling program

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other **___**

Method of Calculation: These data are transformed to achieve normality. Data are ranked into terciles and assign a score of 1 if in the lower third of the distribution, 3 in the middle third, and 5 in the upper third. These ranks are summed to yield the IBI score.

A distribution of the IBI scores was examined. Scores representing the 75^{th}, 50^{th}, and 25^{th} percentiles of the distribution were output. Sites were distributed based on these rankings into groups, where group 3 represented any scores in the upper 25^{th} percentile of the distribution, group 2 scores falling between the 25^{th} and 75^{th} percentiles, and group 1 if scores fell in the lower 25^{th} percentile of the distribution. Tests of significance showed that the groupings were significantly different (p=.0001), and that the groupings were significant from one another. For the INRA/UWA project, a ranking of 2 infers severe disturbance in the fish community, a 5 moderate, and an 8 minimal.

For the UWA, watersheds are placed in Category I (needs restoration) if they are in the lower 25% of scores for the applicable watersheds for the Estuarine Fish IBI. Watersheds are placed in Category II (needs preventative action) if they have scores in the middle 26-74 % of scores for the applicable watersheds. Watersheds are placed in Category III (pristine watersheds) if they have scores in the highest 25% of scores for the applicable watersheds.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___ Other **___**

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ____ No _X

Other Natural Resource Goal: Yes **___** No **_X_**

Assumptions: _____

Estuarine Fish Index of Biotic Integrity - continued

Comments: We feel a little uncomfortable in taking site specific data and rolling it into a gross measure for a watershed. We have seen that the upstream areas (areas closer to the upper part of the watershed - near to the source?) show more disturbance based on the fish community than areas nearer to the mouth of the watershed where main bay effects may buffer the disturbance that is causing fish community disruptions.

This was a quick and dirty exercise that could be developed into a more robust measure that assesses individual measures of the fish community. For example, we may be able to develop measures more specific to recreationally and commercially important species. We could integrate more of the fisheries data (landings, stock assessments) and develop trends using these data. We could also examine trends in community measures and developing a ranking scheme on these. These measures would certainly give a more robust assessment of the condition of the entire fish community in relation to the watershed.

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Anadromous and Semi-anadromous Fish Index

Definition (General Description): Anadromous and semi-anadromous fish were examined for all systems sampled under the Resource Assessment Service, Index of Biotic Integrity sampling program. An index was developed based on the mean catch per unit effort (CPUE) of anadromous and semi-anadromous species combined. Species included in the analysis are defined as follows: Anadromous Species included are American shad, Alewife, Blueback herring, Hickory shad, and Striped bass; Semi-anadromous species included are White perch and Yellow perch.

Data Source: MD Dept Natural Resources, Resource Assessment Service, Index of Biotic Integrity sampling program

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other___

Method of Calculation: The calculations were derived as follows. The CPUE was calculated for every site on a yearly basis. The CPUE was then ranked into five groupings. The mean rank for each river was calculated. These ranks were then multiplied by two to adjust them to a scale ranging from 1 to 10. This index can serve as a fair measure of the value of juvenile anadromous/semi-anadromous fish habitat for each river system.

For the UWA, watersheds are placed in Category I (needs restoration) if they are in the lower 25% of scores for the applicable watersheds for the Anadromous and Semi-anadromous Fish Index. Watersheds are placed in Category II (needs preventative action) if they have scores in the middle 26-74% of scores for the applicable watersheds. Watersheds are placed in Category III (pristine watersheds) if they have scores in the highest 25% of scores for applicable watersheds.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Tidewater Ecosystem Assessments/RAS/DNR

Clean Water Goal: Yes ____ No **_X_**

Other Natural Resource Goal: Yes ___ No **_X_**

Assumptions: _____

Comments: Note that both the IBI and this index are derived from fish information collected with gear that is biased toward juvenile fish communities. Data on adult populations would be a valuable addition to these analysis, as it would allow assessment of the river in terms of the entire fish population. With more time, we could explore data sets (creel census data, fishing reports, landings data, etc.) that may be applicable to this type of exercise.

Anadromous and Semi-anadromous Fish Index - continued

References: see "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for more information.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Coastal Bays Water Quality Index

Definition: The Coastal Bays Water Quality Index is a combination of two current status (1994 - 1996) indexes that were scored on a relative 10-level scale. The habitat status index included information for chlorophyll a and secchi depth and the eutrophicaiton index included information on total suspended solids, total nitrogen and total phosphorus. Values from multiple stations and indexes were consolidated into a single index for each 8 digit watershed.

Data Source: Assateague Island National Seashore Water Quality Monitoring Program and EPA Joint Assessment (Challiou 1996)

Data Type: Condition

Method of Calculation: The same methods were used as described in the "Methods used for Tidal Water Quality, SAV, Benthic IBI and Fish IBI data consolidation for the INRA/UWA project" for tidal water and habitat status indexes with the following exceptions:

A. Data from the National Park Service, Assateague Island National Seashore, was used as the benchmark dataset to determine a relative scale for the coastal bays (univariate analysis was used to determine the 5^{th} and 95^{th} percentiles - e.g. "good and poor endpoints"). The timeframe of this benchmark dataset was 1987 - 1997. This data only included data from Sinepuxent, Newport and Chincoteague Bay watersheds.

B. It was not necessary to calculate median values for station, month, year combinations as there were never more than one value for each station-time combination. The median value for each parameter and station during the 1994 - 1996 period was used in the following equation: $X^* = ((X - \text{"poor endpoint"})/(\text{"good endpoint"} - \text{"poor endpoint"})) \times 100$

C. Due to limited data availability for dissolved oxygen, only chlorophyll a and secchi depth were used to determine the habitat status index.

D. Water Quality Status Indexes for the northern coastal bays (Assawoman and Isle of Wight) were determined from aerial weighted mean values collected during the summer of 1996 (Challiou 1996). This was done due to the lack of data for the full 1994 - 1996 period in these bays. Similar data existed for Newport and Chincoteague Bays. Indexes for these bays were determined for both datasets and were highly comparable.

E. To determine the cutoff values for placement of watersheds into Category I (needs restoration), II (needs preservation) or III (pristine) index scores were determined for the 25 and 75 percentiles. Watershed indexes that fell above the 25 percentile index were considered pristine (category III), those that fell between were considered Category II and those that were above the 25 percentile index were considered Category I.

Coastal Bays Water Quality Index - continued

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Chris Lea, Assateague Island National Seashore Water Quality Monitoring Program, National Park Service and Rick Kutz, EPA

Clean Water Goal: Yes ____ No **_X_**

Other Natural Resource Goal: Yes ___ No **_X_**

Assumptions: _____

Comments: Limited data availability puts less confidence in the indexes calculated for Assawoman and Isle of Wight Bays.

References: Chaillou, J.C., S.B. Weisberg, F.W. Kutz, T.E. DeMoss, L. Mangiaracian, R. Magnien, R. Eskin, J. Maxted, K. Price, J.K. Summers. September 1996. Assessment of the Ecological Condition of the Delaware and Maryland Coastal Bays. EPA/620/R-96/004.

Karrh, R. 1998. Methods Used for Tidal Water Quality, SAV Benthic IBI and Fish IBI data consolidation for the INRA/UWA project. Maryland Department of Natural Resources - Tidewater Ecosystem Assessment (unpublished document).

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Modeled Total Nitrogen or Phosphorus Delivered to the Bay

Definition (General Description): These values include nitrogen loadings for both point and nonpoint sources delivered to the Chesapeake Bay and are represented in pounds per watershed acre.

Data Source: The Chesapeake Bay Program's Phase IV Watershed model (WSM) and the Department of Natural Resource's Integrated Watershed Analysis and Management System (IWAMS).

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: The Watershed Model divides the Chesapeake Bay's 64,000 square mile drainage basin into about 100 model segments. Each segment contains information generated by a hydrologic submodel, a nonpoint source submodel, and a river submodel. The hydrologic submodel uses rainfall, evaporation, and meteorological data to calculate runoff and subsurface flow for all the basin land uses including forest, agricultural lands, and urban lands. The surface and sub surface flow ultimately drive the nonpoint source submodel which simulates soil erosion and the pollutant loads from the land to the rivers. The river submodel routes flow and associated pollutant loads from the land through the lakes, rivers, and reservoirs to the Bay. Please refer to the "Chesapeake Bay Watershed Model Application and Calculation of Nutrient and Sediment Loads", Appendices A through H, for more detailed explanations. These documents may be found at http://www.chesapeakebay.net/bayprogram.

DNR's Integrated Watershed Analysis & Management System is a GIS-based project that is used to track implementation of best management practices, process data from the Watershed Model and calculate nutrient loads and load reductions for Maryland's 8-digit watersheds.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale **_X_** Other: ___

Data Custodian: US Environmental Protection Agency's Chesapeake Bay Program and MD DNR/Chesapeake and Coastal Watershed Service - Watershed Management & Analysis Division - Helen Stewart or Mary Searing at (410) 260-8790.

Clean Water Goal: Yes **_X_** No ___

If Yes: Description of Goal: fishable/swimmable standards for dissolved oxygen

Other Natural Resource Goal: Yes **_X_** No ___

If Yes: Benchmark Goal **_X_** Relative Goal ___

Description of Benchmark: To achieve a 40 percent reduction of controllable sources of nitrogen and phosphorus entering the mainstem Chesapeake Bay by the year 2000 and to maintain at least this level of reduction thereafter.

Modeled Total Nitrogen or Phosphorus Delivered to the Bay - continued

Assumptions: This data is developed using representative models for large watersheds. Actual monitored water quality data may provide different loads and loading rates.

Comments: _____

References:

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Designated Wildlands

Definition (General Description): Acreage of designated wildlands by watershed

Data Source: MD Dept. Natural Resources - Designated Wildlands

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: Sum of designated wildland polygons by watershed.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___
MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Wildland Boundaries - MD Dept. Natural Resources -Resource Planning Division; watershed summary table - DNR-Watershed Management and Analysis Division

Clean Water Goal: Yes ____ No __X__

Other Natural Resource Goal: Yes Digit **_X_** No ___
If Yes: Benchmark Goal ___ Relative Goal Digit **_X_**
Description of Goal: *Protect large, intact naturally functioning ecosystems.*

Assumptions: _____

Comments: Wildlands are defined as "limited areas of land or water which have retained their wilderness character, although not necessarily completely natural and undisturbed, or have rare or vanishing species of plant or animal life or similar features of interest worthy of preservation for use of present and future generations. This may include unique ecological, geological, scenic, and contemplative recreational areas on State lands." (Annotated Coed of Maryland, Natural Resources Article, §5-1201). Legislative designation of a wildland indicates a high societal valuation of intact natural systems.

References:

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Historical Wetland Losses

Definition (General Description): Historical wetland losses as defined by non-wetland hydric soils

Data Source: Natural Soils Groups of Maryland, National Wetlands Inventory (NWI)

Data Type: Condition _X_ Stressor ___ Vulnerability ____ Trend ____ Growth ____ Other _____

Method of Calculation: Hydric soils from Natural Soils Groups of Maryland were intersected with non-NWI wetlands data layer. Acres of resulting soils were summed by watershed.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Natural Soils Group of Maryland - MD Office of Planning; National Wetlands Inventory - US Fish and Wildlife Service; watershed summary table - DNR-Watershed Management and Analysis Division

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal ___ Relative Goal **_X_**

Assumptions 1) Hydric soil was once a wetland before the hydrology was altered. 2) Hydric soil has not become a wetland since the time that NWI classified it. 3) Soil was classified correctly as hydric soil initially.

Comments: Wetlands provide multiple values: hydrologic, water quality and wildlife habitat. Restoration of these values can occur by re-establishing wetlands in areas where the underlying soils are most amenable.

References: Maryland Department of State Planning. 1973. Natural Soils Groups of Maryland. Generalized Land Use Plan Technical Series.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Core Forests containing Headwater Streams

Definition (General Description): Total length of first order streams within interior forest areas by watershed

Data Source: MRLC land cover, Maryland Office of Planning stream coverage

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: Used ARC grid for interior forest (i.e., - forest land greater than 500' from non-forest land) and intersected with 1st order stream grid. Calculated total length of segments 1st order stream segments within interior forest and summed by watershed.

Watershed Scale: Tributary Strategy Region ____ USGS 8 Digit ____ MD 6 Digit ____ MD 8 Digit **_X_** MD 12 Digit ____ Adaptable to Any Scale ____ Other ___

Data Custodian: Source data: MRLC - USEPA; Stream file - Maryland Office of Planning, watershed summary table - DNR-Watershed Management and Analysis Division

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal ___ Relative Goal **_X_**
Description of Goal: *Protect intact headwater forest systems.*

Assumptions: _____

Comments: Can be normalized by watershed area. Forested headwater areas represent pristine, sensitive communities with high value for conservation.

References:

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Watershed Imperviousness

Definition (General Description): Estimate of the area of impervious surface within a watershed

Data Source: MD Office of Planning (OP) 1994 Land Use/Land Cover Data

Data Type: Condition ___ Stressor **_X_** Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: 1994 OP land cover types were assigned a percentage for impervious surface by watershed. Percentages of impervious surface by type of developed land were used based on U.S. Soil Conservation Service TR-55 Manual. Percentages assigned to land use classifications were: 12% for large lot residential, 25% for low density residential, 38% for medium density residential, 65% for high density residential, 85% for industrial, 72% for commercial and other urban uses, and 98% for barren. The general formuala used to derive impervious surface acreage is acres of land classified in that use times percent of impervious surface for that use. Acres of impervious surface total includes acres for each estimated use in a watershed.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___ Other **___**

Data Custodian: Land Cover - MD Office of Planning: watershed summary table - DNR-Watershed Management and Analysis Division

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal ___ Relative Goal **_X_**
Description of Goal: *Conserve and maintain natural hydrologic processes*

Assumptions: Forest, agriculture, wetland, and water land cover types were not considered as factors in watershed imperviousness

Comments: Can be normalized to watershed land area. Impervious surfaces such as roads, parking lots and roof-tops prevent infiltration of rain into groundwater and speed its run-off into surface waters. This not only contributes to flooding, erosion and channel modification at the time of the rainfall event but also can result in the reduction of summer base flow from groundwater. Reduced summer flows in turn have negative impacts on aquatic life.

References:

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Forest Resources

Definition (General Description): Percent of land area in forested land cover

Data Source: MD Office of Planning 1994 Land Use/Land Cover Data

Data Type: Condition **_X_** Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: Sum of acres in forest land cover classification (deciduous, evergreen, mixed, brush) divided by the total watershed land area

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ____
MD 8 Digit **_X_** MD 12 Digit ___ Adaptable to Any Scale ___Other ___

Data Custodian: Land Cover - Maryland Office of Planning; watershed summary table - DNR-Watershed Management and Analysis Division

Clean Water Goal: Yes ____ No _X__

Other Natural Resource Goal: Yes _X__ No ____
If Yes: Benchmark Goal ____ Relative Goal __X__
Description of Goal: *Conserve the forest resource base*

Assumptions: _____

Comments: Forested areas contribute fewer nutrients or other pollutants (e.g., sediment) to surface waters than do other land cover types. Forests provide important wildlife habitat and contribute both air quality and aesthetic benefits, as well.

References:

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Population

Definition (General Description): Office of Planning's 2000 projected population reallocation to watershed and normalized by land acres.

Data Source: MD Office of Planning (MOP)/Dept Natural Resources

Data Type: Condition ___ Stressor ___ Vulnerability ___ Trend _**X**_ Growth _**X**_ Other ___

Method of Calculation: Allocation of estimated MOP population projections to 8-digit watersheds; used 1990 CB Groups

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___ MD 8 Digit _**X**_ MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: DNR/WMA

Clean Water Goal: Yes _**X**_ No ___
If Yes: Description of Goal: *not available*

Other Natural Resource Goal: Yes _**X**_ No ___
If Yes: Benchmark Goal ___ Relative Goal _**X**_
Description of Benchmark: *not available*

Assumptions: _____

Comments: _____

References: _____

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Riparian Vegetative Buffers

Definition (General Description): Acres of riparian area not naturally vegetated

Data Source: MD Office of Planning (OP) 1994 land cover and stream coverage

Data Type: Condition ___ Stressor **_X_** Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: 100 foot wide stream corridor was established based on buffering OP streams data 50' on either side of stream. This corridor was intersected with OP 1994 land cover data to determine the amount of corridor that is not vegetated (i.e., that is in a land cover other than forest or wetland). Unvegetated areas were summed by watershed.

Watershed Scale: Tributary Strategy Region ___ USGS 8-Digit ___ MD 6-Digit ___ MD 8-Digit **_X_** MD 12-Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Land Cover and Stream files - OP; supplementary forest resource data - MD Dept. Natural Resources (DNR)-Forestry Division; watershed summary table - DNR-Watershed Management and Analysis Division

Clean Water Goal: Yes ___ No **_X_**

Other Natural Resource Goal: Yes **_X_** No ___
If Yes: Benchmark Goal ___ Relative Goal **_X_**
Description of Goal: *Conserve and expand naturally vegetated riparian corridors.*

Assumptions: _____

Comments: Can be normalized by total stream corridor area (i.e., - percent of stream corridor not vegetated). Riparian forest is important not only for its ability to buffer streams from the pollution impacts of adjacent land use activities but for the habitat values it provides to both aquatic communities (e.g., food, temperature regulation, bank stability, snags for shelter) and terrestrial communities, for which it can serve both a “local” and a migration corridor function. Riparian wetlands similarly provide important habitat as well as hydrologic functions.

References:

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Soil Erodibility

Definition (General Description): This parameter is developed based on an area's slope, soil erodibility factor, distance to nearest stream and landuse type.

Data Source: Natural Soil Groups of MD, Office of Planning (OP) 1994 Land Use/Land Cover Data

Data Type: Condition _**X**_ Stressor ___ Vulnerability ___ Trend ___ Growth ___ Other ___

Method of Calculation: Four ArcView datalayers were created and overlaid to develop a soil erodibility value for the 8-digit watersheds in MD. These datalayers included the soil erodibility factor (K), the slope steepness, a stream layer with a 1000' buffer and land areas identified as cropland. The soil erodibility factors were assigned to the Natural Soil Group using *Table 1. Estimated Physical and Chemical Properties* in *Natural Soil Groups of MD* Technical Series Report December 1973. Slope was also assigned using the Natural Soils Group properties. The stream datalayer with the 1000' buffer was created using MD streams datalayer and using XTOOLS in ArcView to create a 1000' buffer. The cropland layer was created using MD OP land use cover. The composite value of these layers was normalized and the values were classified into 5 groups using the natural breaks method in ArcView. The classifications high and very high for soil erodibility (corresponding to a numeric value between 0.275 - 0.314 and 0.314 - 0.370, respectively) were used to assign a watershed to the Category 1 rating for this indicator.

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit ___ MD 6 Digit ___
MD 8 Digit _**X**_ MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Mary Searing, Dept. Natural Resources, Chesapeake and Coastal Watershed Services (410) 260-8788

Clean Water Goal: Yes ___ No _**X**_

Other Natural Resource Goal: Yes _**X**_ No ___
If Yes: Benchmark Goal ___ Relative Goal _**X**_
Description of Goal: _____

Assumptions: _____

Comments: This datalayer was created in the early spring of 1998. At the time it was not considered to be needed for use by the state. During the CWAP process, however, it was decided that a soil erodibility index would be a good indicator to include under Category 1 indicators. Due to time constraints, proper QA/QC has not been performed on this datalayer.

Soil Erodibility - continued

References: MD Dept State Planning. 1973. Natural Soils Groups of Maryland.

Data Used in the Clean Water Action Plan Unified Watershed Assessment

Name of Data Layer: Drinking water intakes

Definition (General Description): Surface water intakes for public drinking water systems in Maryland

Data Source: MD Dept. Environment

Data Type: Condition ___ Stressor ___ Vulnerability _**X**_ Trend ___ Growth ___ Other ___

Method of Calculation: River and reservoir intakes were summed by watershed

Watershed Scale: Tributary Strategy Region ___ USGS 8 Digit _**X**_ MD 6 Digit ___ MD 8 Digit ___ MD 12 Digit ___ Adaptable to Any Scale ___ Other ___

Data Custodian: Source data, MD Dept Environment (Patrick DiNicola); watershed summary table, Dept. Natural Resources Watershed Management and Analysis Division (Ted Weber)

Clean Water Goal: Yes _**X**_ No ___

If Yes: Description of Goal: *Ensure safe drinking water for all Marylanders served by public water supply systems (Maryland's Environmental Partnership Agreement, 1998)*

Other Natural Resource Goal: Yes ___ No ___

If Yes: Benchmark Goal ___ Relative Goal ___

Description of Goal: _____

Assumptions: _____

Comments: _____

References: